AMENDMENTS TO THE DRAWINGS

Figures 1A, 1B, and 1C have been amended to indicate that they show prior art.

Figure 11 has been amended to correct the column indication after "90" to "100".

These amendments add no new matter.

REMARKS

The foregoing amendments are responsive to the July 3, 2006 Office Action. Applicant respectfully request reconsideration of the present application in view of the foregoing amendments and the following remarks.

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Response to Objection of Claim 14

Claim 14 has been amended to include the period at the end of Claim 14.

Response to Rejection of Claims 13 and 14 Under 35 U.S.C. 112, second paragraph

The Examiner rejected Claims 13 and 14 under 35 U.S.C. 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 13 and 14 have been amended to correct the antecedent basis issues identified by the Examiner.

Response to Rejection of Claims 1-14 Under 35 U.S.C. 101

The Examiner rejected Claims 1-14 under 35 U.S.C. 101 because the inventions as disclosed in claims are directed to non-statutory subject matter. The independent claims have been amended to clarify that the methods are computer-implemented. Computer-implemented methods are statutory and patentable if they meet the other requirements for patentability. (*See, e.g.*, State Street Bank, 149 F.3d 1368 (Fed. Cir. 1998.)

Response to Rejection of Claim 1 Under Obviousness-Type Double Patenting

The Examiner rejected Claim 1 on the ground of non-statutory obviousness-type double patenting over Claim 1 of copending Application No. 09/676,727 in view of Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard Moment-Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26.

Applicant will timely file a terminal disclaimer should the provisional rejection be sustained once agreement is reached on the claims.

Response to Rejection of Claims 1-4, 6-11, and 13-14 Under 35 U.S.C. 102(b)

The Examiner rejected Claims 1-4, 6-11 and 13-14 under 35 U.S.C. 102(b) as being anticipated by Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard Moment-Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26, hereinafter referred to as Rockwell.

Rockwell (Page 16, second column, Equation (3)) uses the Singular Value Decomposition (SVD)

$$\mathbf{A} = \mathbf{U}\ \mathbf{D}\ \mathbf{V}^h$$

Rockwell uses an expansion of the SVD (See Rockwell, Page 17, first column, Equation (4)) wherein:

$$\mathbf{A} = u_1\ s_1\ v_1^{\ h} + u_2\ s_2\ v_2^{\ h} + \ldots + u_p\ s_p\ v_p^{\ h}$$

The sentence in Rockwell after this equation states, "Here, u_k represents the *k*th column of **U**, s_k represents the *k*th singular value of **A** (e.g., the *k*th diagonal element of **D**), and v_k represents the *k*th column of **V**." In Rockwell, the SVD is used to create pairs of new functions, and the k-th pair is (u_k,v_k). Rockwell teaches that the series given above for **A** may be truncated to use fewer than p pairs of functions, providing an approximation to **A**.

The present application teaches how to produce results other than those of Rockwell. The SVD of A, when used as taught by Rockwell, does not meet the claimed limitations. Rockwell does not teach or suggest that a second set of basis functions and a second set of weighting functions are to be obtained by separate rank reductions. Even if the first and second dimensions are greater than one, Rockwell still teaches a single rank reduction. By contrast, Claim 1 recites a first rank reduction to find a linear combination of sources and a second rank reduction to find linear combinations of testers.

Rockwell does not teach or suggest that a second set of basis functions and a second set of weighting functions are to be obtained by separate rank reductions.

In Rockwell, Equation (4) on Page 17 shows a method for compressing a sub-matrix **A**. Using A, a pair of interdependent basis functions and testing functions was computed using a single rank reduction and these interdependent basis and testing functions were then used

together to compress **A**. These interdependent basis and testing functions were not computed from different rank reductions or from different data.

Moreover, Rockwell does not teach or suggest transforming at least one of the composite sources to cause the composite source to radiate more strongly in a selected region.

Regarding Claim 1, the cited prior art does not make obvious partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to one unknown in a system of linear equations, each of the basis functions corresponding to an original source, selecting a plurality of spherical angles, calculating a far-field disturbance produced by each of the basis functions in a first group for each of the spherical angles to produce a matrix of transmitted disturbances, reducing a rank of the matrix of transmitted disturbances to yield a second set of basis functions, the second set of basis functions corresponding to composite sources, each of the composite sources comprising a linear combination of one or more of the original basis functions, partitioning a first set of weighting functions into groups, each group corresponding to one of the regions, each weighting function corresponding to a condition, each of the weighting functions corresponding to an original tester, calculating a far-field disturbance received by each of the testers in a first group for each of the spherical angles to produce a matrix of received disturbances, reducing a rank of the matrix of received disturbances to yield a second set of weighting functions, the second set of weighting functions corresponding to composite testers, each of the composite testers comprising a linear combination of one or more of the original testers, choosing an angular region, transforming at least one of the composite sources to cause the at least one of the composite sources to radiate more strongly in the angular region, and transforming the system of linear equations to use the composite sources, the at least one composite source, and the composite testers.

The Examiner argues that Rockwell teaches: "Using only the sparse representations of L and U to solve J, not only is the factorizations process faster, ..." The methods of the present application may be used both with a sparse representation and with an explicitly sparse matrix. Rockwell does not teach or suggest creating explicit sparseness as claimed by Applicant. Claim 2 recites setting small-valued elements to zero and then identifying first sub-matrix blocks containing non-zero elements, identifying second sub-blocks containing all zero elements. Rockwell does not make obvious setting small-valued elements to zero and then identifying first

sub-matrix blocks containing non-zero elements, identifying second sub-blocks containing all zero elements.

Regarding Claim 2, the cited prior art does not make obvious a method for factorization of an interaction matrix, comprising: identifying one or more small-valued elements of an interaction matrix; setting the one or more small-valued elements to zero; identifying one or more first sub-blocks in the interaction matrix, the first sub-blocks containing non-zero elements; identifying one or more second sub-blocks in the interaction matrix, the second sub-blocks containing all zero elements; and applying a decomposition to the interaction matrix by performing matrix operations on the first sub-blocks. The Examiner quotes from Rockwell, saying: "a good approximation to A results from approximating the other diagonal elements of D by zero, page 17, left column, paragraph 2". The teaching of Rockwell differ significantly that what is claimed, as approximating diagonal elements of the auxiliary diagonal matrix D by zero is not the same thing as approximating parts of the interaction matrix by zero.

Regarding Claim 3, the cited prior art does not make obvious a system wherein the decomposition comprises an LU decomposition.

Regarding Claim 4, the cited prior art does not make obvious a system wherein the decomposition comprises matrix inversion.

Regarding Claim 6, the cited prior art does not make obvious a system wherein at least one of the matrix operations is performed using optimized software.

Regarding Claim 7, the cited prior art does not make obvious a system wherein either decompositions of first sub-blocks for a first block row below the main diagonal of the interaction matrix are substantially computed before decompositions on a second block row or a substantial number of decompositions of first sub-blocks for a first block column to the right of the main diagonal of the interaction matrix are substantially computed before decompositions on a second block column.

Regarding Claim 8, the cited prior art does not make obvious a system wherein factorization permits direct solution of a system of linear equations and wherein the direct solution comprises the division by a pivot.

The Examiner argues that Rockwell teaches: "Using only the sparse representations of L and U to solve J, not only is the factorizations process faster, ..." The methods of the present

application may be used both with a sparse representation and with an explicitly sparse matrix. Rockwell does not make obvious creating explicit sparseness. Claim 9 recites generating a block-sparse matrix containing substantially full diagonal blocks and containing more than one substantially sparse block where the more than one substantially sparse block contain non-zero elements in substantially similar locations. The Examiner points to block 1 in Figure 5, page 21 of Rockwell. Applicant points out that the sparse representation described by Rockwell block 1 is a representation as an outer product of two vectors (i.e. as a row vector u_1 on the left times a column vector v_1^h on the right). It does not describe block 1 as having zero elements and it does not teach or suggest the method recited in Claim 9.

Regarding Claim 10, the cited prior art does not make obvious a system wherein the decomposition comprises matrix inversion.

Regarding Claim 11, the cited prior art does not make obvious a system wherein the decomposition comprises matrix inversion.

Regarding Claim 13, the cited prior art does not make obvious a system wherein at least one operation using the sub-blocks as a sub-matrix comprises running optimized decomposition software.

Regarding Claim 14, the cited prior art does not make obvious a system wherein the decomposition permits direct solution of a system of linear equations without further division by a pivot.

Accordingly, Applicant asserts that Claims 1-4, 6-11, and 13-14 are allowable over the prior art, and Applicants request allowance of Claims 1-4, 6-11, and 13-14.

<u>Response to Rejection of Claims 5 and 12 Under 35 U.S.C. 103(a)</u>

The Examiner rejected Claims 5 and 12 under 35 U.S.C. 103(a) as being unpatentable over Canning et al., Rockwell Inst. Sci. Center, "Fast Direct Solution of Standard Moment-Method Matrices," IEEE Antennas and Propagation Magazine, June 1998, pages 15-26.

Regarding Claim 5, the cited prior art does not make obvious a method for factorization of an interaction matrix in Claim 2.

Regarding Claim 12, the cited prior art does not make obvious the use of LDM decomposition in connection with the other elements of Claim 9.

Accordingly, Applicant asserts that Claims 5 and 12 are allowable over the prior art, and Applicants request allowance of Claims 5 and 12.

<u>New Claims 15-24</u>

Applicant has added new Claims 15-24. Claims 15-20 depend from previously-filed claims.

Regarding Claim 21, the cited prior art does not render obvious a method of partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to an unknown in a system of equations, each of the basis functions corresponding to an original source; selecting a plurality of spherical angles; calculating a far-field disturbance produced by each of the basis functions in a first group for each of the spherical angles to produce a matrix of transmitted disturbances, using a computing system, reducing a rank of the matrix of transmitted disturbances to yield a second set of basis functions, the second set of basis functions corresponding to composite sources, each of the composite sources comprising a linear combination of one or more of the original basis functions, transforming the system of linear equations to use the composite sources; identifying a plurality of sub-matrices in the transformed system of linear equations, and operating on the plurality of sub-matrices to compute a decomposition, and wherein the decomposition is substantially comprised of second sub-matrices, each of the second sub-matrices corresponding to composite sources produced by reducing a rank of a first matrix of transmitted disturbances, and using the decomposition to solve the transformed system of linear equations.

Regarding Claim 22, the cited prior art does not render obvious a method of partitioning a first set of basis functions into groups, each group corresponding to a region, each basis function corresponding to one unknown in a system of linear equations, each of the basis functions corresponding to an original source, calculating a plurality of far-field disturbances produced by each of the basis functions in a first group to produce a plurality of transmitted disturbances, on a computing system, using the plurality of far-field disturbances to yield a second set of basis functions, the second set of basis functions corresponding to composite sources, each of the composite sources comprising a linear combination of one or more of the original basis functions; transforming the interaction data to produce a second system of linear equations using

the composite sources, wherein a portion of the second system of linear equations is compressed relative to the system of linear equations, the a portion using the composite sources, and wherein the plurality of far-field disturbances is partially described by the interaction data, operating on the transformed system of linear equations to compute a factorization wherein the factorization is compressed relative to the system of linear equations and, and using the factorization to solve the system of linear equations.

Regarding Claim 23, the cited prior art does not render obvious a method of identifying a system of equations described by interaction data, obtaining a plurality of far-field disturbances, using a computer to compute a decomposition of the interaction data wherein a sub-matrix of the decomposition is compressed, the compression of the sub-matrix is computed using only the plurality of disturbances, wherein a portion of the compressed sub-matrix is itself compressed and the plurality of disturbances do not describe interactions described by the portion.

Summary

Applicant respectfully assert that Claims 1-24 are allowable over the prior art, and Applicant request allowance of Claims 1-24. If there are any remaining issues that can be resolved by a telephone conference, the Examiner is invited to call the undersigned attorney at (949) 721-6305 or at the number listed below.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: December 21, 2006

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